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Communication

Agri-Food Land Transformations and Immigrant Farm Workers in Peri-Urban Areas of Spain and the Mediterranean

Karl S. Zimmerer [1,*], Yolanda Jiménez-Olivencia [2], Alejandro Ruiz-Ruiz [2] and Laura Porcel-Rodríguez [3]

1 Department of Geography and GeoSyntheSES Lab, Programs in Rural Sociology and Ecology, Pennsylvania State University, State College, PA 16802, USA
2 Department of Regional and Physical Geography and Institute for Regional Development, Universidad de Granada, 18071 Granada, Spain; yjimenez@ugr.es (Y.J.-O.); alexruiz2@correo.ugr.es (A.R.-R.)
3 Department of Human Geography and Institute for Regional Development, Universidad de Granada, 18071 Granada, Spain; lporcel@ugr.es
* Correspondence: ksz2@psu.edu

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Abstract: Spain is a global hotspot of transformations of agri-food land systems due to changing production intensity, diets, urbanization, market integration, and climate change. Characteristic of the Mediterranean, these expanding intersections with the migration, livelihoods, and food security strategies of immigrant farm workers urge new research into the "who," "how," and "why" questions of the transformation of agri-food land systems. Addressing this gap, we communicate preliminary results from field research in the Granada and Madrid areas. We use a novel conceptual framework of linkages among distinct agri-food land systems and the roles and agency of immigrant farm workers. Preliminary results integrating a combined land- and labor-centric approach address: (1) how the recent and ongoing transformations of specific agri-food land systems are indicative of close links to inexpensive, flexible labor of immigrant farm workers; (2) how the connectivity among transformations of multiple distinct agri-food land systems can be related to the geographic mobility of immigrant farm workers and livelihoods (non-farm work, gendered employment, peri-urban residential location, labor recruitment); and (3) how the struggles for food and nutrition security among immigrant farm workers are indicative of links to local sites and networked agrobiodiversity. This study can help advance the nexus of migration-land research with expanding ethical, justice, and policy concerns of land system sciences in relation to the new suite of agri-food interest and initiatives.

Keywords: land systems; agri-food systems; migration; Spain; Mediterranean; livelihoods; peri-urban; gender; food and nutrition security; ethics and land science

1. Introduction

The transformation of land systems is characteristic of Spain and the Mediterranean region [1,2]. Multiple processes are being transformed in these land systems, which encompass both land use and the related sets of the socioeconomic, technological, and organizational dynamics and, also, the social and ecological interactions [3]. The description of Spain and the Mediterranean as global "hotspots" highlights that "transformations . . . in the intensity of use of agricultural areas have probably been among the most significant" among ongoing land changes [4]. Intensity changes in agriculture and food systems (hence agri-food systems) thus combine with urbanization and climate change as the major drivers of land system transformations in Spain and the Mediterranean [1,2,5].

The concept of transformation in the approaches of social-ecological systems (SES) and political ecology (PE) is well-suited to characterizing major changes in agri-food land systems [6,7]. As used here, "transformation" refers to changing societal relations to nature, especially markets and labor in agri-food systems [8,9]. This combined SES and PE concept of transformation is considered necessary to address interconnected analytical, normative, and political-strategic dimensions.

Characterizing the recent transformation of agri-food land systems in Spain and the Mediterranean begins with the increased prominence of immigrant workers in intensive, industrial agriculture and agribusiness operations for national and export markets [4,10–12]. In Spain, the share of immigrant workers in agriculture has increased significantly since 2000 [13]. This growth paralleled the rate of increased immigrant farm worker populations in other EU countries, though the overall levels in Spain and elsewhere in Southern European countries have been consistently higher [13].[1] During this time, Spain became Europe's largest vegetable and fruit producer and fifth globally [14]. This intensive land system is widely distributed, including concentrations in several peri-urban areas of Spain [15–18].

Transformation of agri-food land systems in Spain and the Mediterranean also entails changes and the often decreased intensity amid continued production of "traditional" agri-food land systems in rural areas [19–23][2]. This transformation type includes widespread extensification of land use (e.g., from annual crops to larger areas of tree crops or livestock-raising; see [26]), which is a subset of the overarching concept of disintensification [27,28]. Disintensification is the general term widely adopted in works on land systems (in addition to [27,28] see also [29–31]) and is used in our study. It is common in marginal agricultural areas of Spain, the Mediterranean, and globally. Disintensified land systems often continue to depend on labor inputs [29,31–33], except in cases of complete land abandonment and dis-occupation.

Changing agri-food land systems in Spain and the Mediterranean are incurring environmental deterioration while offering potential, albeit partial, sustainability. Approaches range from growing interest in sustainable intensification [28,34,35] and the potential role of sustainable place-making [36] to widespread initiatives that support specific agri-food alternatives. These initiatives for agri-food alternatives, which have gained sizable interest and support in Spain and the Mediterranean, include: (i) alternative food systems (AFN) promoting food localization as an alternative to globalization and industrialization [37,38], featuring approaches such as organic certification and labelling [39] and short food supply chains [39–41]; (ii) "local agri-food systems" (Systemes Agroalimentaires Localisés, SYAL) based on the relationship of local food systems and specific territories including agrarian parks [39,42,43]; and (iii) programs for geographical indications, such as protected designation of origin (PDO), which can be treated as a separate approach [20,44].

Research in Spain and the Mediterranean to date has focused on immigrant farm workers as a source of cheap and flexible labor in intensive, industrial agriculture [11,45–49], including vegetable and fruit packing, processing, and export. They are an important element of Spain's population [47,50], forming dynamic new demographic enclaves [51,52]. In southern Spain, which is the primary research site for our study, the largest source of immigrant farm workers is Morocco, which thus represents a multi-country Mediterranean context [48,53]. Precarious conditions of many Moroccans and other immigrant farm worker populations, such as sub-Saharan Africans, Latin Americans, and Eastern Europeans, are acutely vulnerable to food and health insecurity [45], having worsened in the COVID-19 pandemic and threatening to deteriorate further [54–57].

Our research is focused on changing agri-food land systems in relation to the roles and agency of immigrant farm workers in Spain, which has not been studied to date, though its importance is

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[1] Among the immigrant population in Spain, farm work accounts for 10–14% of employment, the highest in the EU and more than twice as high as the country with the second highest level (Italy), though it also shows that immigrant employment was widely distributed among economic sectors [13].

[2] Quotes in the latter term reflect that historical and recent changes characterize "traditional" landscapes in Spain and globally [24,25].

suggested ([58,59]; see also [50,60]). It asks if and how rapidly evolving agri-food land systems are related to the livelihoods of immigrant farm workers, with emphasis on roles of peri-urban land use and residence locations, food security, and social and gender organization of work. It utilizes this journal's "Communication" format to contribute to the Special Issue on "Migration and Land" ([61]; see background in [62]).

We briefly present our conceptual framework and research design before describing the methods (Section 2) and reporting the results on agri-food land systems and the roles of immigrant farm workers (Section 3.1), their livelihoods and residence locations (Section 3.2), and food and nutrition insecurity (Section 3.3). Insights for current research and advancing analysis and policy are discussed (Section 4) and distilled in the Conclusion (Section 5).

Our conceptual framework (Figure 1) is drawn from the above sources with the goal to guide our examination of current land system transformations incorporating migration and immigrant farm workers while, recursively, considering the roles and agency of farm workers. The framework is focused on three themes (Pathways 1–3) and corresponding topics (in boxes). First, we draw on a subset of the above publications (e.g., [1,2,4,5,21,23,24]) to sketch Pathway 1 that guides our research on links between intensification-related transformations of distinct agri-food land systems in Spain and the farm work activities of immigrants (Pathway 1).

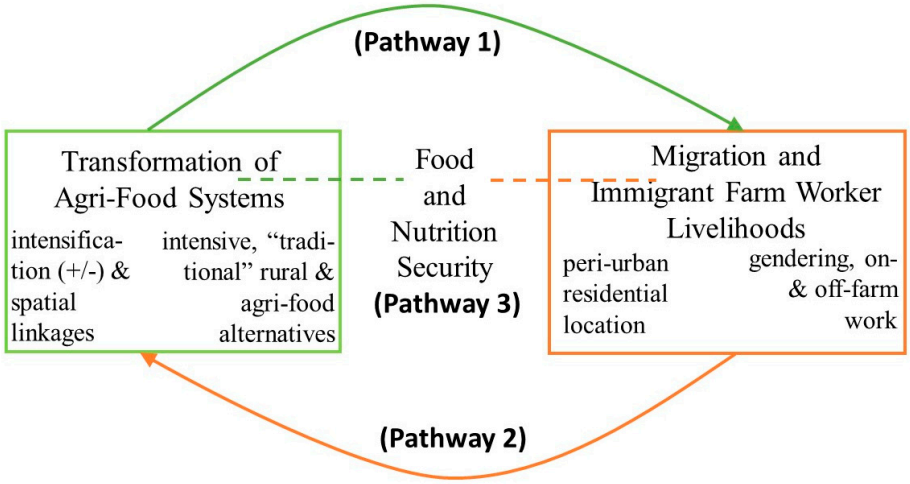

Figure 1. Conceptual framework: themes (Pathways 1–3) and topics (boxes) of the transformation of agri-food land systems and the roles and agency of immigrant farm workers.

We then draw on a second group of above-mentioned sources (e.g., [11,45–48,50–52,58–60]) to sketch Pathway 2 that guides our study of the links of immigrant farm worker livelihoods—defined as the activities, experiences, capabilities, strategies, and well-being factors related to their means of living [63]—to agri-food land systems. To frame this integrated land- and labor-centric approach (Pathways 1 and 2), we focus on the geographic context of peri-urban spaces that are widespread sites of dynamic agri-food land systems in Spain and the Mediterranean with potential linkages involving immigrant farm workers' livelihoods [15–18,58,59,64,65].

Third, we extend this framework to address strategies for the food and nutrition security of immigrant farm workers (Pathway 3). This concern, referring to the accessibility and availability of amounts and types of food that are culturally acceptable, healthy, and include adequate dietary diversity [60,66], combines with issues of immigrant farm worker poverty, employment, health, housing, and justice. By recognizing these issues as incorporated into our focus on food and nutrition security, we engage its specific relevance to "normative land systems science" [67] and long-distance interactions with migrant source areas [62,68,69]. Together, the above pathways, themes, and topics (Figure 1) are a cohesive suite comprising a distinct new approach that complements existing studies

on immigrant farm workers in the capitalist labor market [11], global food system [70], and care ethics (e.g., [71]).

2. Materials and Methods

The principal elements of our conceptual framework (Figure 1 above) were drawn upon to guide the location of research in peri-urban areas of Granada (estimated metropolitan population of 500,000) and Madrid (estimated metropolitan population of 6.4 million) (Figure 2).

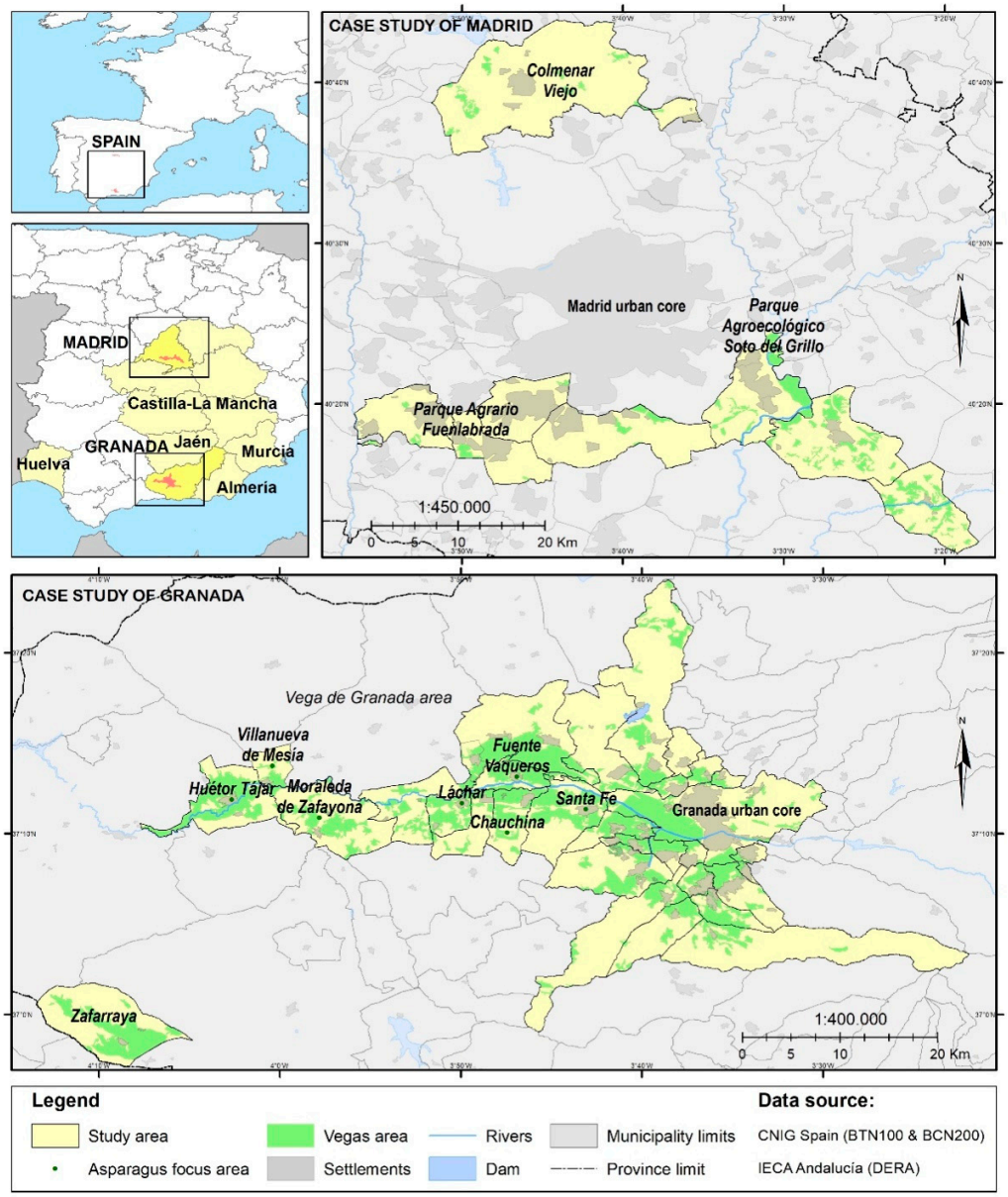

Figure 2. Map of study areas: Granada (lower, principal research) and Madrid (upper, secondary research). Inset map shows other areas mentioned.

Peri-urban space was defined within 80 and 160 kms of the city boundary for medium- and large-size urban areas, respectively [17,72]. We focused primarily on peri-urban Granada (Figure 2; [73]), with rapidly changing agri-food land systems and populations of immigrant farm workers potentially illustrating the pathways in our framework [47,58]. Peri-urban agriculture (PUA) is partly similar to

urban agriculture [74], consisting of diverse types from intensive, conventional production to various alternatives, while PUA typically occupies larger areas [75].

Agri-food systems of peri-urban Granada are concentrated in irrigated areas (*vegas*), especially the extensive Vega of Granada to the west of the city (Figure 2), which is used to produce high-value vegetables and fruit in addition to grain and tree crops (historically sugar beets and tobacco; [32,76]). The agri-food systems of peri-urban Madrid extend around its significantly larger urban core (Figure 2). Conventional agricultural production predominates in the land systems of both these peri-urban areas, which also include alternatives such as agrarian parks (on local food system approaches in peri-urban Madrid, see [77–80].

Guided by our conceptual framework and focus on varied linkages, we used snowball sampling to interview both active immigrant farm workers of non-Spain origin employed primarily in agricultural production and, also, persons employed in related agricultural value chains, though not as farm workers *per se*. A total of 35 persons were interviewed (Supplementary Table S1). Initial contacts were made to farms, agricultural cooperatives, and related organizations in the Granada and Madrid areas through the authors' professional networks. We conducted interviews in 2018 and 2019. The interviews incorporated immigrant farm workers ($n = 23$) in peri-urban areas of Granada ($n = 16$) and Madrid ($n = 7$), as well as agricultural value chain interviews (Supplementary Table S1). The latter included immigrants in agricultural product processing and packing ($n = 2$), non-immigrant farmers ($n = 2$), and mostly non-immigrant farm and agricultural cooperative managers, administrators, and intermediaries ($n = 6$) (Supplementary Table S1).

Interviewees were asked semi-structured and structured questions about agri-food land system linkages to their farm work and livelihoods (see Figure 1; Supplementary Document S1). Interviews lasted 20–40 min. They were conducted in public spaces of work (e.g., fields, reception areas, work floor spaces, and offices), businesses (e.g., cafes), and civic areas (e.g., town plazas). Interviews included a total of 28 men and 7 women, with the average age of 36.7 years (see information characterizing the 35 interviews in Supplementary Table S1). Interviews were conducted in Spanish with the utilization of Arabic and Quechua interspersed in speaking with Moroccan and Bolivian immigrants, respectively. Interviews were recorded with the interviewee's permission. Interview transcriptions numbering 260 pages were then analyzed by category and content analyses. We plan to expand the sample size, methodological design, and analytical approach in continued research.

The Results section incorporates numerical tallies of the immigrant farm worker interviews ($n = 23$) that are presented below in a categorized synthesis in Table 1 and as individual-level results in Supplementary Table S2. Quotes given in the Results section are linked to interview numbers per Supplementary Table S1.

Table 1. Categorized thematic synthesis of the tallied results of immigrant farm worker interviews (n = 23). Background colors in the table correspond to themes of analysis addressed in the text.

		Research Area			
		Granada		Madrid	
	Gender	Male	Female	Male	Total
	Number of Farm Worker Interviews	14	2	7	23
Home Region	Latin America	4	2	2	8
	Africa	10		5	15
Farm Work Activities	Asparagus	3	2		5
	Asparagus and garlic	7			7
	Other vegetables or fruit	3		6	9
	Olive	1			1
	Livestock or dairy			1	1
Agri-Food Land System of Primary Farm Work	Standard export/national markets	12	1		13
	Protected origin (PDO)	1	1		2
	Export and PDO	1			1
	National specialized markets			1	1
	Local food systems (SYAL)			3	3
	National markets			3	3
Secondary Farm Work	Yes	10	2	1	13
	No	4		6	10
Farm Work Space (primary)	Peri-urban	13	2	7	22
	Intensive				0
	Rural	1			1
Farm Work Space (secondary)	Peri-urban	2	1	1	4
	Intensive	1	1		2
	Rural	7			7
Off-/Non-Farm Employment or Main Activity	Construction	7		2	9
	Domestic service (elder care)		2		2
	Own production on rented land	2			2
Location of Residence	Peri-urban	13	2	5	20
	Urban	1		2	3
Worker Organization	Includes work groups (*cuadrillas*)	14	2		16
	Individual only			7	7
Agrobiodiverse Foods in Food Security	Yes	11	2	5	18
	No	3		2	5

3. Results

3.1. Transforming Agri-Food Land Systems and Immigrant Farm Workers

The effects of land system transformation on immigrant farm workers (Pathway 1 in Figure 1) are propelled by Spain's increased labor-intensive production of vegetables and fruits for export over the past decade (Figure 3). Nearly all the farm workers interviewed currently work in this type of production, especially the growing of asparagus, garlic, and other fruits and vegetables (21 of 23 persons; Table 1). This production encompasses systems for conventional markets and for specialized European Union PDO markets. For example, both widespread non-PDO growing and more limited PDO production of asparagus depend extensively on immigrant farm workers. In Granada, three of the 16 interviewees were currently working on PDO asparagus farms, while nine of the others

were engaged in non-PDO asparagus growing (Table 1). Labor demands are concentrated seasonally in the main asparagus harvest in May and a second smaller harvest in August.

Figure 3. Annual vegetable and fruit exports from Spain. Graphic produced by the authors with data from [81].

Seven municipalities in peri-urban Granada are notable for containing more than one half of agricultural land specialized in asparagus (Huétor Tájar, Villanueva de Mesía, Moraleda de Zafayona, Lachar, Santa Fe, Fuente Vaqueros, and Chauchina; "Asparagus focus area"; as detailed in Figure 2). In addition to asparagus-producing land systems, other vegetable crops in Granada, such as garlic, artichoke, strawberries, tomatoes, cucumbers, melons, beans, potatoes, and watermelon, depend heavily on immigrant farm worker labor (Pathway 1 in Figure 1). The crops in this additional intensive production were indicated in the personal experiences of interviewees (Table 1) and in their general descriptions. In the peri-urban Vega of Granada and Zafarraya in southwestern Granada (Figure 2), other intensive production was concentrated and interspersed with asparagus growing.

Distant agri-food land systems in Jaén and Castilla-La Mancha (and to lesser extents Huelva and Almería) were mentioned as currently being a part of immigrant farm worker livelihoods. Twelve of the 16 immigrants interviewed in Granada integrated work in these sites via employer contracts and social networks. Olive production in Jaén and Granada, mostly a rural-based land system, particularly depends on many of the same farm workers employed primarily in intensive, peri-urban vegetable and fruit agriculture. Jobs in rural olive production, especially pruning and harvest, were undertaken by half of these immigrants (8 of 16 persons; Table 1). Nearly all incorporated this highly seasonal olive work as a secondary employment activity, which they combined with their primary labor activities in intensive vegetable and fruit production. This rural work occurred in "traditional" agri-food systems of Jaén and Granada where immigrant farm workers were housed temporarily, sometimes in old farmhouses that had been abandoned (discussed below).

The agri-food land system of expanding olive production amid overall rural de-population is driven by both conventional and PDO product markets. Interviewees described their work as similar in these two production types, though more mechanization and different olive varieties distinguish the former. The olive variety known as "Picual" is widely used in general, whereas PDO producers tend to rely more extensively on the varieties "Hojiblanca" and "Picudo" with favorable traits that feature the less sharp flavor preferred in export. Additional agri-food systems adding to common sites of secondary farm work were the more distant sites of intensive farm work in places in Huelva, Almería, and Castilla-La Mancha (see locations in Figure 2).

Multiple specific agri-food systems in distinct geographic locations comprised spatial circuits of farm labor that were assembled seasonally and annually by many of the interviewed farm workers (Table 1). Peri-urban locations were most common as the primary sites of interviewees' farm work

and rural locations in their secondary farm work. A Bolivian immigrant, for example, described the sequence of farm work sites as peri-urban asparagus growing followed by rural olive production and then returning to peri-urban areas for work in garlic fields. In this case, the aforementioned sequence was then further coordinated with labor in peri-urban sites of potato fields and the second asparagus harvest.

Similarly, a Moroccan farm worker commented: "Timed well we work in [rural] olives, [peri-urban] asparagus, and [peri-urban] garlic; also, in cutting [peri-urban] tobacco" (Interview 11). Another Moroccan farm worker outlined an extensive current sequence of work in olives in rural Granada followed by the strawberry harvest in Huelva, intensive vegetable growing in the greenhouses of Almería, and back to intensive vegetable production in Zafarraya to be followed again by olives in Granada (see locations in Figure 2).

These multiple locations meant that farm workers covered ample swaths of geographic space that reflected nearly continuous labor. As a Moroccan interviewee described: "Agriculture [for farm workers] does not have weekends, holidays, or anything similar" (Interview 21). Common circuits of migration occurred and could be identified among the groups and individuals that we interviewed as detailed above (e.g., Granada/Jaén–Huelva–Almería–Zafarraya; Figure 2), though they varied widely.

Geographically extensive networks and temporally intensive routines reflected the growing inter-dependence of multiple agri-food land systems on immigrant farm worker livelihoods in Granada and the surrounding areas of Spain. One non-immigrant interviewee remarked that the abandoned homes in "traditional" rural areas well outside Granada and its peri-urban area were relicts of the exodus of Spaniards to urban areas during the speculative real-estate bubble of the 2000s. Immigrant farm workers echoed this perception, one commenting "Beginning in 2000 there was the opportunity of speculative bubble of construction and now no one [i.e., Spain-born] works in agriculture" (Interview 16). Interviewees estimated that "foreigners" like themselves comprised a majority and perhaps as much as 80% to 98% of farm labor. "Nearly all this work is done by immigrants" and similar expressions were used to characterize this land use (though national statistical estimates place the overall immigrant worker percentage across all Spanish agricultural sub-sectors at about 25% [13]).

Forms of agriculture being undertaken by first-generation or returnee Spain-born farmers, such as organic farming (a type of alternative food system and thus a distinct agri-food land system, as defined in the Introduction), represented an example of increasing familiarity with immigrant farm workers. In two interviews with this type of farmer (Table 1), both mentioned the capacity to draw on the labor of immigrant farm workers living and working nearby.

In Madrid, the relatively small sample of farm worker interviewees tended to concentrate on certain facets of intensive, peri-urban agriculture and land systems (Table 1), rather than combining peri-urban farm work and rural "traditional" locations as in Granada. Immigrant farm workers interviewed in Madrid specialized in vegetable raising, high-value livestock production and training (fighting bulls), and, in a couple cases, laboring in peri-urban agrarian parks—Parque Agraria Fuenlabrada and the Parque Agroecológico de Soto de Grillo—whose innovative governance and design support agriculture in general and specifically local food systems. One interviewee, a 51-year-old immigrant from Mauritania, described his livelihood experience: "it's good enough to survive but not more or less . . . at least it covers my employment tax and rent though I cannot save for anything else" (Interview 3). Each immigrant farm worker interviewed in Madrid indicated the location of their agricultural work solely in peri-urban land systems; in other words, they do not migrate to undertake farm work in other locations.

3.2. Peri-Urban Livelihood Strategies, Residential Location, and Gender Relations of Immigrant Farm Workers in Relation to Agri-Food Land Systems

The labor, knowledge, skills, and social relations deployed in the livelihoods of immigrant farm workers were anticipated to exert potential influence on transforming agri-food land systems

(Pathway 2 in Figure 1). In Granada, immigrant farm labor has grown rapidly (Figure 4), reflecting the expanding influence of their livelihoods and the importance of their well-being. While such official estimates may be undercounts due to unregistered workers, they suggest overall levels and rates of increase that are high, though lower in magnitude and degree than in Spain's larger centers of immigrant-based agriculture such as Murcia and Almería (Figure 2). Interviewees in our study represented common backgrounds of immigrant farm workers in the Granada and Madrid areas, with Morocco most frequent, followed by Latin America and the combination of sub-Saharan West Africa and the greater Maghreb (Table 1; Supplementary Tables S1 and S2).

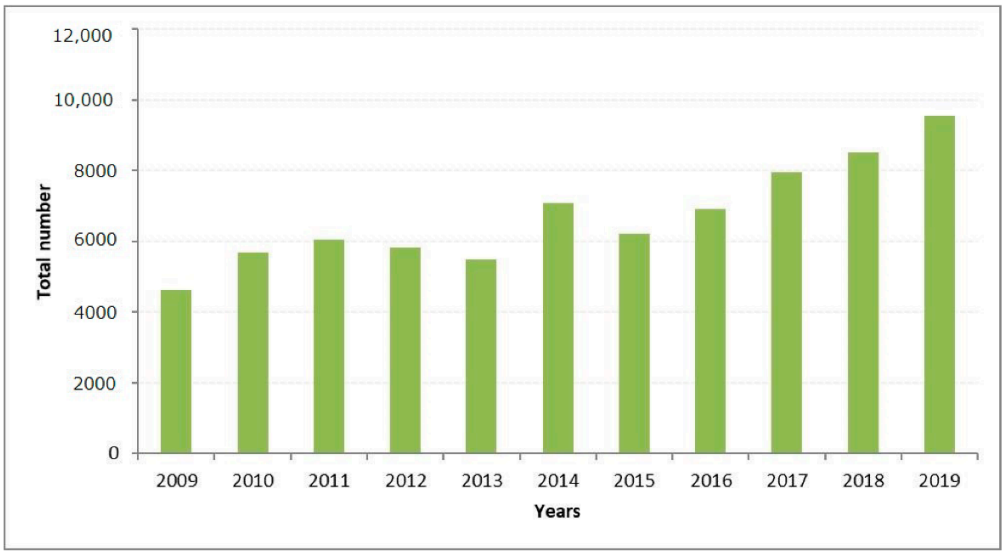

Figure 4. Numbers of government contracts (2009–2019) issued to immigrant farm workers in study sites in Granada (see Figure 2). Graphic produced by the authors with data from [82].

Most interviewees (21 of 23 persons; Table 1) recounted earlier experiences and agricultural backgrounds in food-growing areas of their countries of origin and thus came to Spain with these livelihood capabilities. Once they arrived, several had worked first in Murcia in intensive vegetable and fruit farming for agro-export. One elderly Moroccan farmworker described this stage: "My first job in Spain was in Murcia, . . . [and] was in cotton" (Interview 23). A total of two interviewees had worked recently in Murcia or Almería, though, in general, the nearly year-round calendar of activities in this intensive, agro-export horticulture was unsuited to immigrant farm workers whose livelihoods were based in Granada or Madrid.

Slightly less than one half of male farm worker interviewees (9 of 21; Table 1) were employed periodically in construction. Some had been construction laborers only to switch to farm work after the economic crisis in the late 2000s. One Moroccan immigrant recalled: "Construction was the [original] economic attraction for many agricultural workers. After the crisis [we switched to] agriculture: olives, garlic, everything" (Interview 33). In other cases, construction is actively interspersed with peri-urban farm labor, since "Agricultural work lasts 20 days while in construction the work can last six months" (Interview 14). Another interviewee explained similarly how this livelihood diversification reflected the limited scope of peri-urban farm work in Granada ("the agricultural employment in the Vega of Granada does not represent much work," Interview 32; see also Figure 5).

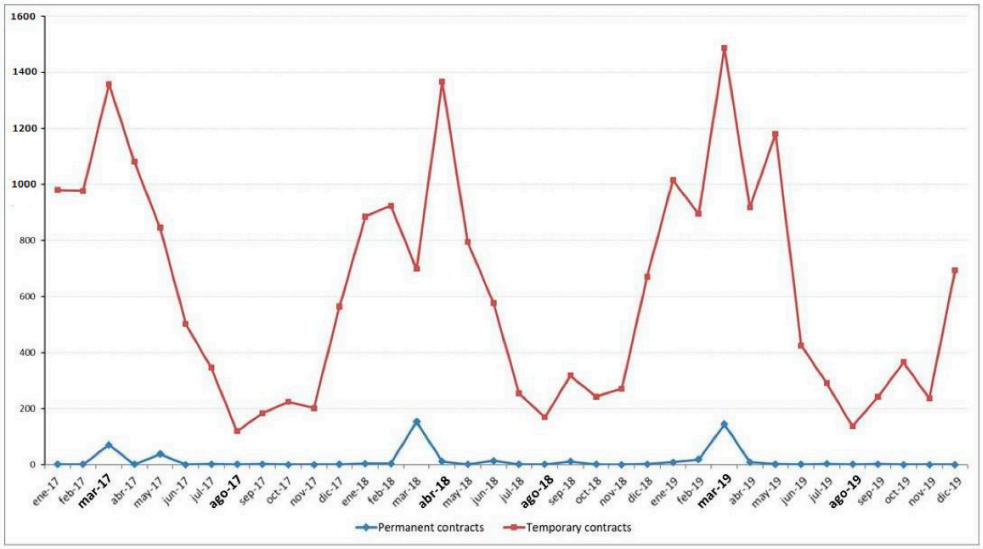

Figure 5. Seasonal fluctuation of the contracts for farm workers based on an example of municipalities in the asparagus-growing area of Granada, 2017–2019. See location details in Figure 2. Graphic produced by the authors with data from [83].

Residential locations in peri-urban spaces, and core urban areas to a lesser extent, were common and central to the livelihoods of the immigrant farm workers we interviewed. In Granada, all the farm worker interviewees except for one (15 of 16 persons; Table 1) resided in smaller towns of the city's peri-urban zone. Peri-urban residential locations were influential in the widespread combination of farm work and non-farm employment, thus exemplifying Pathway 2-type linkages (Figure 1). Jobs in construction were relatively more available and possible in Granada, Madrid, and other urban areas, even though they were typically low-paying, demanding, and dangerous according to interviewees. Moreover, this common incorporation of construction work signaled immigrants' integral contributions to urban and peri-urban expansion as a major, additional land system transformation.

Peri-urban residential locations provided certain work-related advantages to immigrant farm workers that stemmed from their social networks. For instance, more than two thirds of interviewees (16 of 23; Table 1) commonly self-organized into work groups known as *cuadrillas* consisting of 4–20 persons. According to interviewees, the *cuadrilla* groups provided employers with a preferred hiring option since they were readily assembled among peri-urban residents. A Bolivian immigrant experienced in agriculture work in the Vega of Granada commented: "A *cuadrilla* has a head such as me who is placed in charge of recruiting the group. We work together and they call for you" (Interview 16). This capacity to form and recruit labor groups in peri-urban residential locations is recognized by both employers and immigrants as encompassing workers' agency, and thus contributes to Pathway 2-type linkages (Figure 1).

Women contributed to agricultural and non-agricultural livelihood activities that were as significant as their male counterparts, while they similarly depended on coordination enabled by peri-urban residential locations. Women's contribution to agricultural field labor in the peri-urban Vega of Granada, for example, was estimated at 25% and 40% by interviewees, while it was estimated as slightly lower at 15% in the olive production of rural Granada and Jaén. One Bolivian woman commented about the large numbers of immigrant women in agricultural work. "Yes, there are very many [immigrant] women co-workers (literally "collaborators", *compañeras*) in Granada agriculture" (Interview 26). Certain activities, such as garlic harvest, are undertaken nearly exclusively by immigrant women. Many worked in the vegetable and fruit processing and packing plants of cooperatives that employ hundreds of immigrant women in peri-urban Granada. Another Bolivian immigrant, for example,

described her work in the fields in garlic harvest followed by garlic peeling and processing in a packaging plant.

The diversified livelihood strategies of women immigrants who incorporated farm work, though rarely as an exclusive work activity, were facilitated by peri-urban residential locations. Two young immigrant women, originally from Bolivia, described switching to agricultural work from previous employment in elder care to tend to their young children, noting a slightly higher wage and relatively advantageous work scheduling. One explained: "For my daughter I work here in agriculture [and then] I have to pick her up at 4:30 in the afternoon [from daycare]" (Interview 35). Service employment for women of immigrant farm worker households in hotels, restaurants, and cafes was also mentioned (Table 1).

Peri-urban locations were used to leverage additional livelihood advantages among immigrant farm workers. Living costs compared favorably to core urban areas while providing better educational opportunities than smaller or remote rural locations. One Bolivian farm worker summarized this situation by saying she valued the advantage of her children gaining a quality education to pursue careers. Another interviewee, a 19-year-old Moroccan farm worker, described being able to take Spanish courses through a language program offered by his peri-urban municipality. Many peri-urban residential locations housed immigrant neighborhoods, thus helping to provide valuable support for their social and cultural networks and needs, including a range of civic and religious organizations encompassing immigrant rights and aid groups. Moroccan farm workers living near Granada noted the advantages as multifold since they could attend a neighborhood mosque while their children who mainly spoke Spanish could take classes in Arabic.

3.3. Strategies for Food and Nutrition Security and Agrobiodiversity among Immigrant Farm Workers

Practices of immigrant farm workers included strategies to source their own food, to the limited extent that was generally possible, while more importantly being able to obtain and prepare foods, thereby lessening the occurrence and risk of food and nutrition insecurity. Such practices were widespread and relied on varied foodstuffs contributing to health-enhancing dietary diversity (18 of 23 persons; Table 1). For example, Moroccan immigrants in Madrid referred to obtaining well-suited and diverse ingredients in customary foods such as couscous meals on Fridays: "On Fridays couscous is eaten all day" (Interviews 7 and 8). In this weekly custom, it was important to obtain such ingredients as more flavorful squash and parsley types from North Africa through local stores, social networks, and small-scale growing. Other diverse ingredients mentioned as elements of customary food and nutrition included Moroccan radishes, lemon grass, and cilantro.

Bolivian immigrants similarly described customary preferences for multiple types of potatoes, maize, beans, and the Andean chile pepper known as *rocoto*, though in Spain the supply of these agrobiodiverse ingredients is often lacking. While missing specific types, they mentioned being able to grow certain other important dietary inputs, such as a few Andean potato varieties and *rocoto*, whereas Andean maize was noted to have flowered but not to have developed set seed or formed ears.

Strategies to meet food and nutrition security were described by interviewees as comprising three broad activities and corresponding socioeconomic and environmental interactions. First, several referred to increased availability yet high prices at food stores. One farm worker whose immigration dated to the 2000s expanded, "Gradually [these accustomed foods] are available to buy while earlier they were not. When I arrived from Bolivia there were hardly any but now there are" (Interview 5). High store prices, however, often led the immigrants to engage in small-scale growing. *Rocoto* chile peppers could be grown in containers as was being done by several Bolivian farm workers. Similarly, vegetables were sometimes produced in small garden spaces made available by the programs of local municipalities (e.g., the garden program of the municipality of Fuenlabrada in peri-urban Madrid).

In discussing strategies for food security, several interviewees remarked on occasional practices of field gleaning and gifts from farm owners or managers ("bosses"). Gleaning access was typically granted at times of surplus production and was most common in vegetable and tree crops such as

tomatoes and olives. A Moroccan immigrant commented that many "bosses" approved of taking some (small portions of) field production for their families or themselves. Occasional gleaning access was uncertain, though it contributed to the food and nutrition security of immigrant farm workers and was shared within immigrant networks and neighborhoods. One Bolivian observed "because many people harvest tomatoes when the price is at its lowest, they [the field "bosses"] gift you a box" (Interview 33).

One Bolivian women who had immigrated 12 years earlier and was transitioning to farm work after employment in elder care described "we take [gleaned food] to our fellow Bolivians, among those in our group we allot the fruit, the vegetables" (Interview 35). In some instances, the interviewees mentioned a field owner or manager gifting olive oil and farm animals such as a sheep. Immigrants recognized that these gleaning and gifting practices, like land access (discussed below), solidified the recruitment and retention of cheap, flexible labor benefitting farm owners and managers. The immigrant farmworkers occasionally obtained access to small planting and growing areas within fields and farm spaces and, in some cases, were able to rent fields for their own production. One Moroccan farm worker remarked: "Last year my boss gave me a small amount of land and I planted squash, watermelon, a small amount of eggplant, cucumber, tomatoes" (Interview 6). Another noted "There are immigrant farm workers who plant for their own consumption within the field of their boss" (Interview 22).

Similarly, a Bolivian worker outlined how farm owners granted the use of a row or two as field space for his own planting since he and his spouse did not have any land access. Still, another Bolivian described herself and five others as renting small fields that she described as *huertos* ("gardens"). This term referred to their use for vegetable production since the rented land encompassed nearly one hectare and supplied both their own food and market sales. In sum, these strategies for immigrant food and nutrition security entailed small but important agri-food land systems.

Finally, a secondary emphasis of the interviews on the conditions contributing to initial immigration and continued long-distance connections to social networks in home countries led to accounts of numerous examples of foods, food production, and cultural foodways. While our results emphasized dynamics in Spain, our interviews provide preliminary information concerning long-distance flows to and from immigrant source areas of Morocco, Mauritania, Senegal, Bolivia, Ecuador, and other countries. Interviewees generally described these flows as distinguished by migrants sending remittances and having been propelled to migrate due to the lack of adequate livelihood, educational, and inter-generational opportunities. The latter was redoubled by factors of worsening climate change, which were mentioned extensively in relation to Mauritania and Senegal. Past influence and continued connections to these geographic areas included the innovation and use of knowledge and skills about food production and preparations. They frequently described these connections as improving access and quality of foods that were nutritious and culturally valued in diets. The role of agrobiodiverse foods in immigrant eating that was common (Table 1) entailed many descriptions of ongoing exchanges of information related to seed availability and the viability of growing.

4. Discussion

The results of preliminary research demonstrate the usefulness of the conceptual framework that was developed and applied (Figure 1). It revealed the multi-directional linkages between the transformation of agri-food land systems and the roles and agency of immigrant farmer workers. The framework guided our empirical focus on immigrant farm workers in principal agri-food land systems of Spain and the Mediterranean that include intensive vegetable growing for national and export markets, disintensification of "traditional" rural production, and key functions of peri-urban geographic spaces [5,16,18,84]. Transformations of these agri-food systems reflect the analytic, normative, and political-strategic meanings of "transformation" in current approaches in political ecology (PE) and social-ecological systems (SES). We focus on transformations tied to diverse, complex processes of peri-urbanization (expansion of spaces and functions at the urban fringe [15,17,72,85].

The results offer new insight into the "who," "how," and "why" questions of the interconnected transformation of multiple agri-food land systems characteristic of Spain and the Mediterranean. Increased labor-demanding agriculture and decreased "traditional" rural production together with urbanization and peri-urban growth are powerfully transforming these land systems and urge examination of the roles and agency of immigrant farm workers. This focus in our study is designed as a complement to rapidly expanding remote sensing-based spatial and statistical research in Spain and the Mediterranean [1,2,4,5,18]. While vital, these studies urgently require the development of new conceptual approaches and empirical studies.

Better understanding the roles and agency of immigrant farm workers was key to addressing the above-mentioned "who," "how," and "why" questions. Integrating a labor-centric approach, our results demonstrate how and why immigrant farm worker livelihoods in peri-urban Granada span both intensive agricultural production and continued, albeit changing, "traditional" rural production. By contrast, results in Madrid suggest immigrant farm workers tend to concentrate in peri-urban areas. We hypothesize that this contrast reflects the specific location of the Madrid interviews in peri-urban areas at the fringe close to the urban core that constrains geographic mobility to rural spaces. In addition, the Madrid interviews represented a smaller sample size. Overall, our perspective broadens agri-food research on immigrants in peri-urban spaces of Spain and the Mediterranean that has tended to focus exclusively within these spaces [58,59]. Moreover, peri-urban rootedness and spanning of immigrant farm workers to multiple agri-food land systems (Section 3.1) can be related to social-ecological connectivity and political-ecological networks [86,87].

Gendering, residential location, and sociocultural factors were major influences shown in our results (Section 3.2). Interviews revealed that immigrant men and women in peri-urban areas are actively assembling diversified livelihoods of extensive farm, non-farm, and family work. This adds an important perspective to the existing depictions of peri-urban space in successive immigrant re-locations [50] and urban–rural relations [34]. Livelihood diversification is grueling in its demands and complex regarding its linkages (on devalued, diversified labor of women immigrants in Spain, see [88]; on agri-food and environmental linkages, see [28]). Peri-urban spaces were the sites of their nearly constant struggles to coordinate informal farm and non-farm employment. Results elucidated how and why the livelihoods of immigrant farm workers are embedded in extensive urban–rural linkages of agricultural activities and social networks [89].

Our study suggests new insight into how the food and nutrition security of immigrant farmworkers is tied not only to livelihoods but also to agri-food land systems. We anticipate this insight can contribute to increasing interest and potential future importance of normative land systems science [67] and landscape approaches [90] on food and nutrition security as well as social justice concerning food-growing populations. A related insight concerns their role in peri-urban land systems, for example, that can potentially partner with expanding movements for city-, region-, and national-scale food and nutrition security (e.g., Spain's Red Inter-Vegas initiative). Another potential insight for policy and programs stems from the demonstrated roles of immigrant farm workers in specific forms of agri-food alternatives (detailed in Results and defined in the Introduction) that have continued to expand in Spain [39]. Participation in these programs, as described above, can potentially strengthen the resilience and social inclusion of immigrants in Spain and elsewhere (e.g., [60,91,92]).

Finally, results on networks connecting immigrant farm workers in Spain to their home countries suggest insight on telecoupling (the interactions and flows of materials and information between "receiving" and "receiving countries" [62,68,69]). While telecoupling was only a minor element in the interview, it guided select results relevant to this Special Issue on migration–land interactions. Results suggest that the interactions of migrant telecoupling extend beyond the well-known sending of remittances in one direction and labor in the other [68] to also include food knowledge and practices (such as production, preparation, and consumption). In addition to strengthening food and nutrition security, this food-related telecoupling can be related to the nutritious and agroecologically important biodiversity of food and agriculture (agrobiodiversity) in both receiving and sending locations [69,93].

5. Conclusions

Based on the above results and discussion, we conclude that our proposed conceptual framework effectively guided preliminary empirical research on specific interactions of the ongoing transformations of agri-food land systems with the roles and agency of immigrant farm workers. First, we identified how certain specific elements indicative of the ongoing transformations of multiple agri-food land systems in Spain can be related to the inexpensive, flexible labor of immigrant farm workers. Second, we demonstrated the labor-centered linkages indicative of connectivity among specific transformations of both intensive vegetable production for national and export markets and changing "traditional" rural production. This connectivity can be related to the geographic mobility of immigrant farm workers and factors in their livelihood practices incorporating off- and non-farm work, gendered work processes, peri-urban residential location, and labor recruitment. Third, the results illustrated practices indicative of strategies for food and nutrition security among immigrant farm workers involving local sites and, in some cases, the role of networked agrobiodiversity.

These conclusions derive from our preliminary research undertaken in the Granada and Madrid areas of Spain, while, at the same time, the study's general framing is designed to encompass anticipated applicability elsewhere in Spain and the Mediterranean. Regarding the themed Special Issue on "Migration and Land," our study concludes by reflecting on the prominent interactions of agri-food land systems and previously less well-known, multi-directional linkages entailing the roles and agency of immigrant farm workers. Our conclusions elucidate the influence of major drivers that include rapidly expanded national and global market integration as well as complex land systems in peri-urban areas that are propelled by urbanization while they incorporate agri-food production spaces. Finally, we conclude that evidence is indicative of the major roles played by the labor and livelihoods of immigrant farm workers, together with the specific factors mentioned in the preceding paragraph and detailed in our results and discussion. This conclusion advises that scientific analyses, policies, and programs for the sustainability of agri-food systems need to account for both the importance and agency of immigrant farm workers and, also, their justice, livelihood, and well-being concerns.

Supplementary Materials: The following are available online at http://www.mdpi.com/2073-445X/9/12/472/s1, Supplementary Document S1: Interview Questions; Supplementary Table S1: Interview Information; Supplementary Table S2: Individual-Level Interview Results.

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